

Eurocode 5: Design of timber structures —

**Part 1.1: General rules and rules for
buildings —**

**(together with United Kingdom
National Application Document)**

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National foreword

This publication comprises the English language version of ENV 1995-1-1:1993 *Eurocode 5 — Design of timber structures — Part 1.1: General rules and rules for buildings*, as published by the European Committee for Standardization (CEN), plus the National Application Document (NAD) to be used with the ENV for the design of buildings to be constructed in the United Kingdom (UK).

ENV 1995-1-1:1993 results from a programme of work sponsored by the European Commission to make available a common set of rules for the design of building and civil engineering works.

An ENV is made available for provisional application, but does not have the status of a European Standard. The aim is to use the experience gained during the ENV period to modify the ENV so that it can be adopted as a European Standard.

The values for certain parameters in the ENV Eurocodes may be set by CEN members so as to meet the requirements of national regulations. These parameters are designated by $\square$ (boxed values) in the ENV.

It should be noted that ENV 1995-1-1 design is based on partial factors and characteristic values for actions and material properties, in contrast to BS 5268 which uses permissible stress values.

During the ENV period reference should be made to the supporting documents listed in the National Application Document (NAD). The purpose of the NAD is to provide essential information, particularly in relation to safety, to enable the ENV to be used for buildings constructed in the UK. The NAD takes precedence over corresponding provisions in the ENV.

The Building Regulations 1991, Approved Document A 1992 (published December 1991), draws designers' attention to the potential use of ENV Eurocodes as an alternative approach to Building Regulation compliance. ENV 1995-1-1 has been thoroughly examined over a period of several years and is considered to offer such an alternative approach, when used in conjunction with this NAD.

Compliance with ENV 1995-1-1:1993 and the NAD does not of itself confer immunity from legal obligations.

Users of this document are invited to comment on its technical content, ease of use and any ambiguities or anomalies. These comments will be taken into account when preparing the UK national response to CEN to the question of whether the ENV can be converted to an EN.

Comments should be sent in writing to BSI, British Standards House, 389 Chiswick High Road, Chiswick, London W4 4AL, quoting the document reference, the relevant clause and, where possible, a proposed revision, within 2 years of the issue of this document.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to xxii, the ENV title page, pages 2 to 76, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

National Application Document for use in the UK with ENV 1995-1-1:1993

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Introduction

This National Application Document (NAD) has been prepared under the direction of the Technical Sector Board for Building and Civil Engineering. It has been developed from:

- a) a textual examination of ENV 1995-1-1:1993;
- b) a parametric calibration against UK practice, supporting standards and test data;
- c) trial calculations.

It should be noted that this NAD, in common with ENV 1995-1-1 and supporting CEN standards, uses a comma where a decimal point would be used in the UK.

1 Scope

This NAD provides information required to enable ENV 1995-1-1:1993 (EC5-1.1) to be used for the design of buildings and civil engineering structures to be constructed in the UK.

2 References

2.1 Normative references

This National Application Document incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on page xxi. For dated references, only the edition cited applies: any subsequent amendments to or revisions of the cited publication apply to this British Standard only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This National Application Document refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on page xxii, but reference should be made to the latest editions.

3 Partial safety factors, combination factors and other values

- a) The values for partial safety factors (γ) should be those given in Table 1 of this NAD.
- b) The values for combination factors (Ψ) should be those given in Table 2 of this NAD.
- c) The values for other boxed values should be those given in Table 3 of this NAD.

Table 1 — Partial safety factors (γ factors)

Reference in EC5-1.1	Definition	Symbol	Condition	Value	
				Boxed EC5	UK
2.3.3.1	Partial factors for variable actions	γ_A	Accidental	1,00	1,00
		$\gamma_{F,inf}$	Favourable	0,0	0,0
		γ_Q	Unfavourable	1,5	1,5
		γ_Q	Reduced favourable	0,0	0,0
		γ_Q	Reduced unfavourable	1,35	1,35
2.3.3.1	Partial factors for permanent actions	γ_{GA}	Accidental	1,0	1,0
		γ_G	Favourable	1,0	1,0
		γ_G	Unfavourable	1,35	1,35
		$\gamma_{G,inf}$	Favourable	0,9	0,9
		$\gamma_{G,sup}$	Unfavourable	1,1	1,1
		γ_G	Reduced favourable	1,0	1,0
		γ_G	Reduced unfavourable	1,2	1,2
2.3.3.2	Partial factors for materials	γ_M	Timber and wood based materials	1,3	1,3
		γ_M	Steel used in joints	1,1	1,1
		γ_M	Accidental	1,0	1,0
		γ_M	Serviceability	1,0	1,0

Table 2 — Combination factors (ψ factors)

Variable action	Building type	ψ_0	ψ_1	ψ_2
Imposed floor loads	Dwellings	0,5	0,4	0,2
	Other occupancy classes ^a	0,7	0,6	0,3
	Parking	0,7	0,7	0,6
Imposed ceiling loads	Dwellings	0,5	0,4	0,2
	Other occupancy classes ^a	0,7	0,2	0,0
Imposed roof loads	All occupancy classes ^a	0,7	0,2	0,0
Wind loads				

^a As listed and defined in Table 1 of BS 6399-1:1984.

Table 3 — Boxed values (other than γ values)

Reference in EC5-1.1	Definition	Value	
		Boxed EC5	UK ^a
4.3.1(2)	Deflections		
	General $u_{2,inst}$ For cantilever $u_{2,inst}$	$\leq l/300$ $\leq l/150$	$\leq l/300$ $\leq l/150$
4.3.1(3)	General $u_{2,fin}$	$\leq l/200$	$\leq l/200$
	For cantilever $u_{2,fin}$	$\leq l/100$	$\leq l/100$
	General $u_{net,fin}$	$\leq l/200$	$\leq l/200$
	For cantilever $u_{net,fin}$	$\leq l/100$	$\leq l/100$
4.4.2(2)	Vibrations From machinery multiplying factor	1	1
4.4.3(2)	Residential floors equation (4.4.3a) equation (4.4.3b)	1,5 100	1,5 100
^a Unlike EC5-1.1, this NAD requires 5-percentile stiffness moduli to be used to calculate deformations for solid timber members acting alone [see 6.4 a) of this NAD].			

4 Loading codes

The loading codes to be used are:

BS 648, *Schedule of weights of building materials*.

BS 6399, *Design loading for buildings*.

BS 6399-1, *Code of practice for dead and imposed loads*.

BS 6399-3, *Code of practice for imposed roof loads*.

CP 3, *Code of basic data for the design of buildings*.

CP 3:Chapter V, *Loading*.

CP 3:Chapter V-2, *Wind loads*.

In using these documents with EC5-1.1 the following modifications should be noted:

- Loads from separate sources or of different durations acting on a member or component should be considered as separate actions.
- The design loading on a particular member or component may include the relevant load combination factors described in 2.3.2.2 and 4.1 of EC5-1.1. Alternatively for the ultimate limit state the simplification of design load given in 2.3.3.1(5) of EC5-1.1 may be used. For deformations a simplification is given in 6.4 b) of this NAD.
- The reductions in total imposed floor load described in clause 5 of BS 6399-1:1984 should be disregarded.
- Snow loads arising from local drifting should be treated as an accidental loading condition with the local drift being the accidental action A_d , in equation (2.3.2.2b) of EC5-1.1, and the duration of this accidental loading being short term.
- The wind loading should be taken as 90 % of the value obtained from CP 3:Chapter V-2.

5 Reference standards

The supporting standards to be used, including materials specifications and standards for construction, are listed in Table 4.

Table 4 — References in EC5 to other publications

Reference in EC5	Document referred to	Document title or subject area ^a	Status	UK document ^b
2.1P(2)	—	Requirements on accidental damage and structural integrity	—	Approved Document A of the Building Regulations [1]
2.2.2.2	ENV 1991	<i>Basis of design and actions on structures</i>	In preparation	BS 648 BS 6399 CP 3 (See clause 4 of this NAD)
2.3.1P(4)	—	Testing	—	Section 8 of BS 5268:1991 BS EN 380 BS EN 595 ^c BS 5268-6.1
2.4.2P(1)	EN 350-2 EN 335-1 EN 335-2 prEN 335-3 prEN 351-1 prEN 460	Durability of wood Hazard classes of wood and wood-based products against biological attack Preservative treatment Guide to durability requirements	prEN subject to CEN formal vote 1992 1992 prEN subject to CEN formal vote prEN subject to CEN formal vote Published 1994	BS EN 350-2 ^c BS EN 335-1 BS EN 335-2 BS EN 335-3 ^c BS EN 351-1 ^c BS EN 460
Table 2.4.3	ISO 2081 EN 10147	Metallic coatings	1986 1991	BS EN 10147
Table 3.1.7	prEN 312 prEN 300 prEN 622	Particleboards OSB Fibreboards	prEN subject to CEN formal vote prEN subject to CEN enquiry prEN subject to CEN enquiry	BS EN 312 ^c BS EN 300 ^c BS EN 622 ^c
3.2.1P(3)	prEN 518	Visual grading	prEN subject to CEN formal vote	BS EN 518 ^c
3.2.1P(4)	prEN 519	Machine grading	prEN subject to CEN formal vote	BS EN 519 ^c
3.2.2	prEN 338 prEN 384 prEN 408 prEN 1193	Strength classes of structural timber Characteristic values Test methods Test methods	prEN subject to CEN formal vote prEN subject to CEN formal vote prEN subject to CEN formal vote prEN subject to CEN enquiry	BS EN 338 ^c BS EN 384 ^c BS EN 408 ^c prEN 1193 ^c
3.2.3	prEN 336	Timber sizes and tolerances	prEN subject to CEN formal vote	BS EN 336 ^c
3.2.5	prEN 385	Finger joints	prEN subject to CEN formal vote	BS EN 385 ^c
3.3.1	prEN 386	Performance and production of glued laminated timber	prEN subject to CEN formal vote	BS EN 386 ^c
3.3.2	prEN 408 prEN 1193 prEN 1194	Test methods for glued laminated timber Test method Characteristic values	prEN subject to CEN formal vote prEN subject to CEN enquiry prEN subject to CEN enquiry	BS EN 408 ^c BS EN 1193 ^c BS EN 1194 ^c
3.3.3	prEN 390	Sizes of glued laminated timber	prEN subject to CEN formal vote	BS EN 390 ^c
3.3.5	prEN 387	Performance and production of large finger joints	prEN subject to CEN formal vote	BS EN 387 ^c
3.4.1	prEN 636-1 prEN 636-2 prEN 636-3 prEN 1058	Plywood Characteristic values of wood-based panels	prENs subject to CEN enquiry	BS EN 636-1 ^c BS EN 636-2 ^c BS EN 636-3 ^c BS EN 1058 ^c ITD/1 [2]

^a See 1.7 of EC5-1.1 for titles of European Standards, published and in preparation.^b For titles of published UK documents see the list of references to this NAD.^c British Standard in preparation.

Table 4 — References in EC5 to other publications

Reference in EC5	Document referred to	Document title or subject area ^a	Status	UK document ^b
3.4.2	prEN 312-4 prEN 312-5 prEN 312-6 prEN 312-7 prEN 300 prEN 1058	Particleboards OSB Characteristic values of wood-based panels	prENs subject to CEN enquiry	BS EN 312 ^c BS EN 300 ^c BS EN 1058 ^c ITD/2 [3]
3.4.3	prEN 622-3 prEN 622-5 prEN 1058	Fibreboards Characteristic values of wood-based panels	prENs subject to CEN enquiry	BS EN 622 ^c BS EN 1058 ^c ITD/2 [3]
3.5	EN 301	Adhesives	1992	BS EN 301
4.1(3)	EN 26891	Strength and deformation of joints made with mechanical fasteners	1991	BS EN 26891
Table 4.1	prEN 312-1 prEN 300 prEN 622-1	Particleboards OSB Fibreboards	prEN subject to CEN formal vote prEN subject to CEN enquiry prEN subject to CEN enquiry	BS EN 312 ^c BS EN 300 ^c BS EN 622-1 ^c
4.4.2	ISO 2631-2	Vibration	1989	
5.4.3	prEN 594	Design and testing of wall panels	prEN subject to CEN enquiry	BS 5268-6.1
6.1P(1)	EN 26891 EN 28970	Strength and deformation of joints made with mechanical fasteners Test methods	1991 1991	BS EN 26891 BS EN 28970
7.9.1 7.9.2(2)	prEN 1059	Trusses	prEN subject to CEN enquiry	—
D.2(3)	EN 26891	Strength and deformation of joints made with mechanical fasteners	1991	BS EN 26891
D.6.3 1) D.6.4	prEN 1075	Test methods for joints made from punched metal plates	No draft	

^a See 1.7 of EC5-1.1 for titles of European Standards, published and in preparation.
^b For titles of published UK documents see the list of references to this NAD.
^c British Standard in preparation.

6 Additional recommendations

6.1 Guidance on EC5-1.1

When designing to EC5-1.1, 6.2 to 6.7 should be followed.

6.2 Chapter 2. Basis of design

a) Clause 2.1P(2)

The design requirements for providing structural integrity by limiting the effects of accidental damage are given in sections 5 and 6 of Approved Document A 1992 of the Building Regulations 1991 [1].

a) Clause 2.3.1P(4)

ENV 1991-1 (EC1-1.1) *Basis of design* is currently being drafted to give guidance on the structural testing and evaluation procedures to be used when the design information in Eurocodes 2 to 9 is insufficient, or where economies may result from tests on prototypes.

Until the above document is available, prototype testing of assemblies should be carried out to the standards listed below, and the results assessed in accordance with the requirements of section 8 of BS 5268-3:1985 for trussed rafters and section 8 of BS 5268-2:1991 for other assemblies, modified as follows.

NOTE For the design and testing of timber frame wall panels, see 6.5 d) of this NAD.

Tests should be carried out to:

BS EN 380 for general structural components;

BS EN 595¹⁾ for trussed rafters.

The worst loading condition, referred to as the design load, should be determined without the use of the γ_F and Ψ factors.

For trussed rafters the acceptance load should be assessed in accordance with **39.3** of BS 5268-3:1985 except that the value for K_t should be taken from Table 5 of this NAD assuming loads are long term. For other assemblies the acceptance load should be determined by multiplying the design load by the relevant factor from Table 5. The material categories are those given in Table 3.1.7 of EC5-1.1, i.e.

Category 1 Solid and glued laminated timber and plywood

Category 2 Particleboards to BS EN 312-6^{ab} and BS EN 312-7^a
OSB to BS EN 300^a Grades 3 and 4

Category 3 Particleboards to BS EN 312-4^{ab} and BS EN 312-5^a
OSB to BS EN 300^a Grade 2
Fibreboards to BS EN 622-5^a (hardboard)

Category 4 Fibreboards to BS EN 622-3^a (medium boards and hardboards)

^a In preparation.

^b Not to be used in service class 2.

Where actions of different durations act in combination, the shortest duration of the actions may be used to determine a factor from Table 5, provided its induced stress is at least 50 % of the total.

For trussed rafters the permissible deflections should be assessed in accordance with **39.2** of BS 5268-3:1985. For other multiple member components the permissible deflections for a prototype test should be assessed as given in clause **62** of BS 5268-2:1991, but the following should be noted.

— The “specified amount of deflection in the design” should be calculated as the instantaneous deflection (u_{inst}) in EC5-1.1.

— The definitions of duration of load for determining K_{72} and K_{80} should be those given in BS 5268-2. For example, if a load is to simulate a snow load, then the factor (K_{72} or K_{80}) would be determined for medium term as given in BS 5268-2, and not short term as given in EC5-1.1.

Table 5 — Factors for testing

Service duration of actions or combination of actions	Number tested	Material category			
		1	2	3	4
Long term	1	2,50	3,50	3,84	4,28
	2	2,29	3,21	3,53	3,94
	3	2,16	3,02	3,32	3,70
	4	2,05	2,87	3,17	3,52
	5 or more	2,00	2,80	3,07	3,42
Medium term	1	2,18	2,50	2,66	2,58
	2	2,01	2,29	2,45	2,62
	3	1,89	2,16	2,30	2,47
	4	1,80	2,05	2,19	2,35
	5 or more	1,74	2,00	2,13	2,28
Short term	1		1,94	2,03	2,14
	2		1,79	1,88	1,96
	3		1,68	1,75	1,84
	4		1,60	1,68	1,77
	5 or more		1,56	1,62	1,71
Instantaneous	1			1,59	
	2			1,46	
	3			1,37	
	4			1,30	
	5 or more			1,27	

¹⁾ In preparation.

6.3 Chapter 3. Material properties

a) Clause 3.1.5

The examples in Table 6 indicate the appropriate service class.

Table 6 — Examples of appropriate service class

Service class	Environmental conditions
1	Timber in buildings with heating and protected from damp conditions. Examples are internal walls, internal floors (other than ground floors) and warm roofs.
2	Timber in covered buildings. Examples are ground floor structures where no free moisture is present, cold roofs, the inner leaf of cavity walls and external single leaf walls with external cladding.
3	Timber fully exposed to the weather. Examples are the exposed parts of open buildings and timber used in marine structures.

b) Clause 3.1.6P(2)

The load duration class is not only determined by the estimated duration of the characteristic load but also, to a lesser extent, by the duration of loads lower than the characteristic value. In view of the difficulty of assessing the appropriate duration without specialist knowledge, the examples given in EC5-1.1 should be used for design in the UK, with the following additional information.

- 1) Imposed roof loads, where access is limited to maintenance and repair, should be considered as short term actions.
- 2) Imposed roof loads, other than snow loads, where access is not limited should be considered as medium term actions.
- 3) Uniformly distributed imposed loads on ceilings should be considered as long term actions.

c) Table 3.1.7

Because it is difficult to dry timber more than 100 mm thick, unless it is specially dried, the stresses and moduli for service class 3 should normally be used for solid timber members more than 100 mm thick.

d) Clause 3.2.1

Visual and machine strength grading should be carried out under the control of a third party certification body, authorized by the UK Timber Grading Committee. Only structural timber carrying the mark of a certification body approved by the UK Timber Grading Committee should be used (see Annex A).

e) Clause 3.2.2

Characteristic values should be obtained from the strength classes given in BS EN 338²⁾.

If characteristic values are developed for use outside the strength class system, they should be assessed by the British Standards Institution working group, B525/5/WG1, and the grading quality control and certification should be assessed by the UK Timber Grading Committee.

Machine grading is carried out directly to the strength class boundaries and the timber is marked accordingly with a strength class number. Species which can be machine graded, and the strength classes to which they are assigned, are given in Table 7, Table 8 and Table 9.

Table 7, Table 8 and Table 9 also give the strength classes to which various visual grades and species are assigned.

f) Clause 3.2.2P(3)

No size adjustments to tension perpendicular to grain and shear stresses are applicable for solid timber.

g) Clause 3.2.3

Timber sizes normally available in the UK are given in the National annex to BS EN 336²⁾.

²⁾ In preparation.

Although BS 4978 does not permit cross-section sizes less than 35 mm × 60 mm to be stress graded, research now shows that sizes down to and including 35 mm × 45 mm may be graded to BS 4978 and are acceptable for use with the design rules of EC5-1.1 and the strength properties of BS EN 338³⁾.

In common with BS 5268-2, the S8 and S6 grades, specified in the ECE standard on sawn timber [6], are interchangeable with the SS and GS grades, respectively, of BS 4978.

NOTE The grading rules for the two standards mentioned above differ for square cross sections. The ECE rules for square sizes are equally acceptable in terms of strength properties and give higher yields.

h) Clause 3.2.5

For EC5-1.1, finger joints to any required specification should be manufactured and tested to BS EN 385³⁾ to determine their characteristic strength. This is different from the system used in BS 5268-2, where a table relates grades to efficiencies, and in BS 5291 which relates efficiencies to joint specification.

It is essential that finger joints in principal members, as defined in BS 5268-2, have third party quality assurance by a certification body approved by the National Accreditation Council of Certification Bodies (NACCB).

i) Clause 3.3.2(2)

The glulam strength class system given in prEN 1194 makes use of laminates from the solid timber strength class system given in BS EN 338³⁾.

j) Clause 3.3.2P(3)

The definition of width in tension is the largest cross-sectional dimension, which for glulam is usually the summation of the laminate thicknesses.

k) Clause 3.2.5

It is essential that large finger joints have third party quality assurance by a certification body approved by the NACCB.

l) Clause 3.4.1.2

Until the European standard with characteristic values for plywood is published, values converted from BS 5268-2 and given in ITD/1 [2] should be used.

m) Clause 3.4.2.2

Until the European standard with characteristic values for particleboards is published, values for structural grade chipboard should be obtained from ITD/2 [3].

n) Clause 3.4.3.2

Until the European standard with characteristic values for fibreboards is published, values converted from the grade values in BS 5268-2 may be used for tempered hardboard. These should be obtained from ITD/2 [3].

³⁾ In preparation.

Table 7 — BS 4978 and NLGA^a NGRDL^b joist and plank visual grades and species and CEN machine grades assigned to strength classes

Type	Species	Source	Grade ^c	Strength class
Imported softwoods	Redwood	Europe	SS GS Machine	C24 C16 C14 to C30
	Whitewood	Europe	SS GS Machine	C24 C16 C14 to C30
	Hem-fir, S-P-F and DF-L	Canada and USA	SS GS Machine JP Sel JP No. 1 JP No. 2	C24 C16 C14 to C30 C24 C16 C16
	Sitka spruce	Canada	SS GS JP Sel JP No. 1 JP No. 2	C18 C14 C18 C14 C14
	Southern pine	USA	SS GS Machine JP Sel JP No. 1 JP No. 2 JP No. 3 ^d	C24 C18 C14 to C30 C30 C22 C22 C16
	Western white woods	USA	SS GS JP Sel JP No. 1 JP No. 2	C18 C14 C18 C14 C14
	Western red cedar	Imported	SS GS	C18 C14
	Parana pine	Imported	SS GS	C24 C16
	Pitch pine	Caribbean	SS GS	C27 C18
	Radiata pine	New Zealand	Machine	C14 to C30
	Radiata pine	Chile	Machine	C14 to C30
	S. African pine	S. Africa	Machine	C14 to C30
	Zimbabwean pine	Zimbabwe	Machine	C14 to C30
British grown softwoods	Spruce	UK and Ireland	SS Machine	C18 C14 to C24
	Pine		SS GS Machine	C22 C14 C14 to C27
	Larch		SS GS Machine	C24 C16 C14 to C27
	Douglas fir		SS GS Machine	C18 C14 C14 to C24

^a National Lumber Grades Authority (Canada)

^b National Grading Rules for Dimension Lumber (USA).

^c Grades are from the following: SS and GS from BS 4978, JP from *Standard grading rules for Canadian lumber* [4] and *The national grading rules for dimensioned lumber* [5] and machine grades from EN 519 (in preparation).

^d Joist and plank grade No. 3 should not be used for tension members.

Table 8 — NLGA^a/NGRDL^b structural light framing, light framing and stud grades assigned to strength classes

Species	Source	Grade	Section size (mm)					
			38 × 89	38 × 38	38 × 63	63 × 63	63 × 89 89 × 89	38 × 114 38 × 140
DF-L	Canada and USA	SLF Sel	C24	C24	C24	C24	C24	
		SLF No. 1	C16	C18	C18			
		SLF No. 2	C16	C18	C18			
		SLF No. 3 ^c		C14	C14	C14		
		LF Const ^c	C14				C14	
		Stud ^c	C14	C14	C14	C14		
Hem-fir	Canada and USA	SLF Sel	C24	C24	C24	C24	C24	
		SLF No. 1	C16	C18	C18			
		SLF No. 2	C16	C18	C18			
		SLF No. 3 ^c		C14	C14	C14		
		LF Const ^c	C14				C14	
		Stud ^c	C14	C14	C14	C14		
S-P-F	Canada and USA	SLF Sel	C24	C24	C24	C24	C24	
		SLF No. 1	C16	C18	C18			
		SLF No. 2	C16	C18	C18			
		SLF No. 3 ^c		C14	C14	C14		
		LF Const ^c	C14				C14	
		Stud ^c	C14	C14	C14	C14		
Sitka spruce	Canada	SLF Sel	C16	C18	C18	C18	C18	
		SLF No. 1	C14	C14	C14			
		SLF No. 2	C14	C14	C14			
Western white woods	USA	SLF Sel	C16	C18	C18	C18	C18	
		SLF No. 1	C14	C14	C14			
		SLF No. 2	C14	C14	C14			
Southern pine	USA	SLF Sel	C27	C30	C27	C27	C24	
		SLF No. 1	C22	C24	C24			
		SLF No. 2	C22	C24	C24			
		SLF No. 3 ^c	C16	C18	C16	C18		
		LF Const ^c	C18	C16	C14	C14	C18	
		LF Std ^c	C14		C14	C14	C14	
		Stud ^c	C16	C18	C16	C16	C16	C16

^a National Lumber Grades Authority (Canada).^b National Grading Rules for Dimension Lumber (USA).^c Should not be used for tension members.

Table 9 — Hardwood grades and species assigned to strength classes

Type	Species	Source	Grade ^a	Strength class
Tropical hardwoods	Kapur	SE Asia	HS	D60
	Kempas	SE Asia	HS	D60
	Keruing	SE Asia	HS	D50
	Ekki	W Africa	HS	D60
	Balau	SE Asia	HS	D70
	Greenheart	SE Asia	HS	D70
	Iroko	Africa	HS	D40
	Jarrah	Australia	HS	D40
	Karri	Australia	HS	D50
	Merbau	SE Asia	HS	D60
	Opepe	Africa	HS	D50
	Teak	SE Asia and Africa	HS	D40
^a Grades are from BS 5756.				

6.4 Chapter 4. Serviceability limit states

a) Clause 4.1(3)

Instantaneous deformation is defined as deformation without creep.

The instantaneous deformation of a solid timber member acting alone should be calculated using the appropriate 5-percentile modulus of elasticity ($E_{0,05}$) and/or 5-percentile shear modulus ($G_{0,05}$). Where two or more pieces of solid timber are joined together to act as a single member, the mean values of the elastic moduli may be used.

For solid timber, $G_{0,05} = 0,063E_{0,05}$

b) Clause 4.1(6)

Where a combination of actions with different load durations occurs on an element or structure, and when all such actions are uniformly distributed, the final deformation of that element or structure may be estimated directly under the combined action by using an effective k_{def} in equation (4.1b) of EC5-1.1 as follows: The design

$$k_{\text{def,ef}} = \frac{1}{Q_{\text{tot}}} \left[0.8 \Sigma G_{\text{kj}} + Q_{\text{k},1} k_{\text{def},1} + \sum_{i > 1} \psi_{1,i} Q_{\text{k},i} k_{\text{def},i} \right]$$

where

$k_{\text{def,ef}}$ is the effective deformation factor for the element or structure being considered under combined action Q_{tot} ;

Q_{tot} is the combined action calculated from equation (4.1a) of EC5-1.1;

$k_{\text{def},i}$ is the deformation factor from Table 4.1 of EC5-1.1 appropriate to the duration of action $Q_{\text{k},i}$.

c) Clause 4.2

The values of K_{ser} assume that holes in steel members have the minimum clearance compatible with the dowel-type fastener to be used (see 7.4 of EC5-1.1).

d) Clause 4.2(3) and 4.2(5)

The value of 1 mm incorporated in equations (4.2d) and (4.2e) of EC5-1.1 is to allow for the clearance hole for a bolt.

e) Clause 4.4.1

The requirements in this clause are not appropriate to normal UK floors, which are not fully supported on all four sides and do not have significant transverse stiffness. See 6.4 f) of this NAD.

f) *Clause 4.4.3*

For type 1 residential UK timber floors as defined in Table 1 of BS 6399-1, which are primarily supported on two sides only and do not have significant transverse stiffness, it is sufficient to check that the total instantaneous deflection of the floor joists under load does not exceed 14 mm or $l/333$, whichever is the lesser.

6.5 Chapter 5. Ultimate limit statesa) *Clause 5.2.2*

The value $\sigma_{m,crit}$ for rectangular sections can be obtained from the following equation:

$$\sigma_{m,crit} = \frac{0.75E_{0.05}b^2}{L_{ef}h}$$

The effective value of L_{ef} is governed by the degree of restraint against:

- 1) lateral deflection;
- 2) rotation in plan; and
- 3) twisting.

As a guide:

- where full restraint is provided against rotation in plan at both ends, $L_{ef} = 0,7L$;
- where partial restraint against rotation in plan is provided at both ends or full restraint at one end, $L_{ef} = 0,85L$;
- where partial restraint against twisting is provided at one or both ends, $L_{ef} = 1,2L$.

b) *Clause 5.4.1.4P(4)*

For the purposes of lateral stability calculations on rafter members, the effective length for out-of-plane buckling should be taken as the distance between discrete restraints, provided these are adequately fixed to the member and anchored to a braced part of the structure.

c) *Clause 5.4.1.5(1)*

Irrespective of any other design requirements, the maximum bay length of trussed rafter chord members, when measured on plan between node points, should be limited to the values given in Table 10 and the maximum overall length of internal members should be limited to the values given in Table 11.

Where necessary, intermediate values may be obtained by linear interpolation.

d) *Clause 5.4.3*

The design method for timber frame walls given in EC5-1.1 lacks sufficient information with regard to the determination of racking resistance (F_k) from the test method. This NAD will be revised in due course to give the required additional information. Until that revision is published, timber frame wall panels should be designed and tested to BS 5268-6.1.

6.6 Chapter 6. Jointsa) *Clause 6.1*

Glued joints should be designed taking into consideration the strength properties of the timber and/or wood-based members to be joined, which are assumed to be weaker than the glue.

Table 10 — Maximum bay length of rafters and ceiling ties

Depth of member (mm)	Maximum length (measured on plan between node points) (m)			
	35 mm thick		47 mm thick	
	Rafter	Ceiling tie	Rafter	Ceiling tie
72	1,8	2,4	3,0	3,0
97	2,3	3,0	3,3	4,0
122	2,5	3,4	3,6	4,7
147	2,8	3,7	3,8	5,0

Table 11 — Maximum length of internal members

Depth of member (mm)	Maximum length (measured on plan between node points) (m)	
	35 mm thick	47 mm thick
60	2,4	3,2
72	3,6	4,8
97	4,5	6,0

b) Clause 6.1(9)

The ultimate limit state slip modulus K_u is applicable in ultimate limit state calculations where the influence of fastener slip on strength needs to be considered. Joint slip should be calculated by dividing the applied design load per fastener (at either service load or ultimate load level) by the appropriate fastener slip modulus.

c) Clause 6.2.1

The formulae for R_d provide characteristic design resistances for the ultimate limit state. They should not be used to establish design resistances at the service load level.

Connected joints

Until prEN 912 (the specification for connectors for timber), a standard for characteristic load carrying capacities and slip moduli for connectors, and a design method for connected joints are available, characteristic load carrying capacities for connectors should be obtained by multiplying the basic loads tabulated in BS 5268-2 by a factor of 2,6 for toothed plate connectors and 2,9 for split-ring and shear plate connectors. The design capacity is given by the following equation:

$$R_d = k_{\text{mod}} \times \text{characteristic value for connector} / \gamma_M$$

where

k_{mod} and γ_M are the values for solid timber and glulam.

The standard spacings and distances given in BS 5268-2 should be used, unless the characteristic values are reduced by the appropriate factors for substandard spacings and distances, given in BS 5268-2.

6.6 Annex D. The design of trusses with punched metal plate fasteners**a) Clause D.2**

The value of u_{ser} can be taken as the average initial slip value published in the appropriate British Board of Agrément (BBA) certificate.

The value of K_{ser} can be obtained from the following equation:

$$K_{\text{ser}} = F_{a,00,k} \times A_{\text{ef}} / (2,5 \times u_{\text{ser}})$$

b) Clause D.6.2

Unless experience indicates that a larger tolerance is necessary, A_{ef} should allow for a minimum misalignment of 5 mm simultaneously in two directions parallel to the edges of the punched metal plate fastener. In addition, allowance should be made for any ineffective nails nearer than certain specified distances from the edges and ends of the timber and published in a British Standard, a BBA certificate or a certificate of assessment from an accredited body which provides equivalent levels of protection and performance.

c) Clause D.6.3

Characteristic anchorage capacities for metal plate fasteners should be obtained directly from a British Standard, a BBA certificate or a certificate of assessment from an accredited body which provides equivalent levels of protection and performance, by multiplying the permissible long-term loads per nail by a factor of 2,5 and dividing by the area per nail. Linear interpolation may be used to obtain intermediate characteristic capacities.

The design anchorage capacity is given by the following equation:

$$R_d = k_{\text{mod}} \times \text{characteristic anchorage capacity} / \gamma_M$$

where

k_{mod} and γ_M are the values for solid timber.

Characteristic tension, compression and shear capacities of metal plate fasteners should be obtained by multiplying the permissible forces published in the appropriate BBA certificate by 2,33. Linear interpolation may be used to obtain intermediate characteristic capacities.

The design tension, compression and shear capacities of metal plate fasteners are given by the following equation:

$$R_d = k_{\text{mod}} \times \text{characteristic capacity} / \gamma_M$$

where

$$k_{\text{mod}} = 1,0 \text{ and } \gamma_M = 1,1.$$

Annex A (informative)**Acceptable certification bodies for strength graded timber**

Certification bodies currently approved are listed in Table A.1 to Table A.5.

NOTE A leaflet containing an illustration of each grading stamp logo and the address of each certification body⁴⁾, can be obtained from the UK Timber Grading Committee, The Timber Trade Federation, Clareville House, 26/27 Oxendon Street, London SW1Y 4EL.

Table A.1 — Certification bodies approved to oversee the supply of visually strength graded timber to BS 4978

Certification body	UK representative	Certification body	UK representative
AFPA	COFI	QLMA	BPIB
CLA	BPIB	SPIB	WWPA/SFPA
CLMA	COFI	SGMCF	NTC
COFI	COFI	SSTCC	NTC
ILMA	COFI	TRADACERT	TRADACERT
MI	COFI	WCLIB	MI
MLB	BPIB	WWPA	WWPA
OLMA	BPIB		
PLIB (Can)	COFI		
PLIB (USA)	WWPA		

Table A.2 — Certification bodies operating under the Canadian Lumber Standards Accreditation Board (CLSAB) approved for the supply of visually strength graded timber to the NLGA grading rules

Certification body	UK representative	Certification body	UK representative
AFPA	COFI	MLB	BPIB
CLA	BPIB	NLPA	BPIB
CLMA	COFI	OLMA	BPIB
COFI	COFI	PLIB (Can)	COFI
ILMA	COFI	QLMA	BPIB
MI	COFI		

Table A.3 — Certification bodies operating under the American Lumber Standards Board of Review (ALS) approved for the supply of visually strength graded timber to the NGRDL grading rules

Certification body	UK representative	Certification body	UK representative
PLIB (USA)	WWPA	WCLIB	WWPA
SPIB	WWPA/SFPA	WWPA	WWPA
TPI	WWPA/SFPA		

⁴⁾ Addresses of the UK representative referred to in Table A.1 to Table A.5 are as follows:

Bureau de Promotion des Industries du Bois (BPIB), Unit 3, Blenheim Court, 7 Beaufort Park, Woodlands, Almondsbury, Bristol BS12 4NE Tel. 0454 616000 Fax 0454 616080

Council of Forest Industries of British Columbia (COFI), Tileman House, 131-133 Upper Richmond Road, London SW15 2TR Tel. 081 788 4446 Fax 081 789 01480

TRADA Certification Ltd. (TRADACERT), Stocking Lane, Hughenden Valley, High Wycombe, Bucks HP14 4NR Tel. 0494 565484 Fax 0494 565487

BSI Quality Assurance (BSIQA), PO Box 375, Milton Keynes, Bucks MK14 6LL Tel. 0908 220908 Fax 0908 220671

Nordic Timber Council UK (NTC), 17 Exchange Street, Retford, Notts DN22 6BL Tel. 0777 706616 Fax 0777 704695

Southern Pine Marketing Council (SFPA) and Western Wood Products Association (WWPA), 65 London Wall, London EC2M 5TU

Table A.4 — Certification bodies approved to oversee the supply of machine strength graded timber to BS EN 519^a (both machine control and output control systems)

Certification body	UK representative
BSIQA TRADACERT	BSIQA TRADACERT
^a In preparation.	

Table A.5 — Certification bodies approved to oversee the supply of machine strength graded timber to BS EN 519^a (output control system only)

Certification body	UK representative	Certification body	UK representative
AFPA CLMA COFI ILMA MI PLIB (Can)	COFI COFI COFI COFI COFI COFI	SPIB TPI WCLIB WWPA QLMA	WWPA/SFPA WWPA/SFPA WWPA WWPA BPIB
^a In preparation.			

List of references (see clause 2)

Normative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 648:1964, *Schedule of weights of building materials.*

BS 5268, *Structural use of timber.*

BS 5268-2:1991, *Code of practice for permissible stress design, materials and workmanship.*

BS 5268-3:1985, *Code of practice for trussed rafter roofs.*

BS 5268-6, *Code of practice for timber frame walls.*

BS 5268.6.1:1988, *Dwellings not exceeding three storeys.*

BS 6399, *Design loading for buildings.*

BS 6399-1:1984, *Code of practice for dead and imposed loads.*

BS 6399-3:1988, *Code of practice for imposed roof loads.*

CP 3, *Code of basic data for the design of buildings.*

CP 3:Chapter V, *Loading.*

CP 3:Chapter V-2:1972, *Wind loads.*

BS EN 301:1992, *Adhesives, phenolic and aminoplastic, for load-bearing timber structures: classification and performance requirements.*

BS EN 335, *Hazard classes of wood and wood-based products against biological attack.*

BS EN 335-1:1992, *Classification of hazard classes.*

BS EN 335-2:1992, *Guide to the application of hazard classes to solid wood.*

BS EN 380:1993, *Timber structures — Test methods — General principles for static load testing.*

BS EN 460:1994, *Durability of wood and wood-based products — Natural durability of wood — Guide to the durability requirements to be used in hazard classes.*

BS EN 10147:1992, *Specification for continuously hot-dip zinc coated structural steel sheet and strip — Technical delivery conditions.*

BS EN 26891:1991, *Timber structures — Joints made with mechanical fasteners — General principles for the determination of strength and deformation characteristics.*

BS EN 28970:1991, *Timber structures — Testing of joints made with mechanical fasteners — Requirements for wood density.*

ISO publications

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO), GENEVA. (All publications are available from BSI Sales.)

ISO 2081:1986, *Metallic coatings — Electroplated coatings of zinc on iron or steel.*

ISO 2631, *Evaluation of human exposure to whole-body vibration.*

ISO 2631-2:1989, *Part 2: Continuous and shock-induced vibrations in buildings (1 to 80 Hz).*

Other references

[2] TIMBER RESEARCH AND DEVELOPMENT ASSOCIATION. *Plywood properties for use with Eurocode 5: Interim technical data sheet ITD/1.* London: TRADA, 1993⁵⁾.

[3] TIMBER RESEARCH AND DEVELOPMENT ASSOCIATION. *Structural chipboard and tempered hardboard properties for use with Eurocode 5: Interim technical data sheet ITD/2.* London: TRADA, 1993⁵⁾.

⁵⁾ Available from TRADA, Stocking Lane, Hughenden Valley, High Wycombe, Bucks HP14 4NR.

Informative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 4978:1988, *Specification for softwood grades for structural use*.

BS 5291:1984, *Specification for manufacture of finger joints of structural softwood*.

BS 5756:1980, *Specification for tropical hardwoods graded for structural use*.

Other references

[1] GREAT BRITAIN. The Building Regulations 1991, Approved Document A 1992 *Requirements on accidental damage and structural integrity*. London: HMSO.

[4] NATIONAL LUMBER GRADES AUTHORITY. *Standard grading rules for Canadian lumber*. Vancouver: NLGA, 1993⁽⁶⁾⁽⁷⁾.

[5] NATIONAL GRADING RULES FOR DIMENSIONED LUMBER. *The national grading rules for dimensioned lumber*. NGRDL, 1993⁽⁸⁾.

[6] ECONOMIC COMMITTEE FOR EUROPE (ECE). *Sawn timber: Recommended standard for stress grading of coniferous sawn timber*. Geneva: ECE, 1982.

⁽⁶⁾ The relevant section of the rules is Section 4 which is technically equivalent to the *National Grading Rules for Dimensioned Lumber* [5].

⁽⁷⁾ Available from: Council of The Forest Industries of British Columbia, Tileman House, 131-133 Upper Richmond Road, London SW15 2TR.

⁽⁸⁾ Available from: Southern Pine Marketing Council and Western Wood Products Association, 65 London Wall, London EC2M 5TU.

Eurocode 5 — Design of timber structures — Part 1.1: General rules and rules for buildings

Eurocode 5 — Calcul des structures en bois —
Partie 1.1: Règles générales et règles pour les
bâtiments

Eurocode 5 — Entwurf, Berechnung und
Bemessung von Holzbauwerken —
Teil 1.1: Allgemeine
Bemessungsregeln, Bemessungsregeln
für den Hochbau

This European Prestandard (ENV) was approved by CEN on 1992-11-20 as a prospective standard for provisional application. The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard (EN).

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

01 Objectives of the Eurocodes

The Eurocodes constitute a group of standards for the structural and geotechnical design of building and civil engineering works. They will cover execution and control to the extent that it is necessary to indicate the quality of the construction products and the standard of workmanship needed on and off-site to comply with the assumptions of the design rules. While the necessary set of harmonised technical specifications for products and methods for testing their performance is not available, the Eurocodes may cover some of these aspects.

The Eurocodes are intended to serve as reference documents for the following purposes:

- a) as a means to prove compliance of building and civil engineering works with the essential requirements of the Construction Products Directive;
- b) as a framework for drawing up harmonized technical specifications for construction products.

02 Background to the Eurocode programme

The Commission of the European Communities (CEC) initiated the work of establishing a set of harmonised technical rules for the design of building and civil engineering works which would initially serve as an alternative to the differing rules in force in the various Member States and, ultimately would replace them. These technical rules became known as the “Structural Eurocodes”.

In 1990, after consulting their respective Member States, CEC and EFTA Secretariat transferred the work on further development, issue and updating of Eurocodes to CEN.

In CEN, Technical Committee CEN/TC 250 has overall responsibility for the Structural Eurocodes.

03 Eurocode programme

Work is in hand on the following Eurocodes each consisting of a number of parts:

EC 1: Basis of design and actions on structures

EC 2: Design of concrete structures

EC 3: Design of steel structures

EC 4: Design of composite steel and concrete structures

EC 5: Design of timber structures

EC 7: Geotechnics

EC 8: Design of structures in seismic regions

EC 9: Design of aluminium structures (subject to Mandate)

For each Eurocode listed above, CEN/TC 250 has formed a Sub-committee.

This part of Eurocode EC5 which had been finalised and approved for publication under the direction of CEC, is being issued by CEN as European Prestandard (ENV). It is intended for experimental practical application in the design of building and civil engineering works covered by the scope of the Prestandard as given in Clause 1.1.2.

Feedback and comments on this prestandard should be sent to the Secretariat of Sub-Committee SC5 at the following address:

SIS

BST

Drottning Kristinas väg 73

S-11428 STOCKHOLM

04 National application documents

In view of the responsibilities of Members of states for the safety health and other matters covered by the essential requirements, certain safety elements in this ENV have been assigned indicative values. The authorities in each Member state are expected to assign definitive values to these safety elements.

Many of the supporting standards, including those giving values for actions to be taken into account and measures required for fire protection, will not be available by the time this Prestandard is issued. It is therefore anticipated that a National Application Document giving definitive values for safety elements, referencing compatible supporting standards and giving national guidance on the application of this Prestandard will be issued by each Member State or its Standard Organisation. This Prestandard should be used in conjunction with the National Application Document valid in the country where the building and civil engineering work is to be constructed.

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1 Introduction

1.1 Scope

1.1.1 Scope of Eurocode 5

P(1) Eurocode 5 applies to the design of timber structures — i.e., structures made of timber (solid timber, sawn, planed or in pole form, and glued laminated timber) or wood-based panels jointed together with adhesives or mechanical fasteners. It is subdivided into various separate parts, see 1.1.2 and 1.1.3.

P(2) Eurocode 5 is only concerned with the requirements for mechanical resistance, serviceability and durability of structures. Other requirements, e.g. concerning thermal or sound insulation, are not considered.

P(3) Execution⁹⁾ is covered to the extent that is necessary to indicate the quality of the construction materials and products which should be used and the standard of workmanship on site needed to comply with the assumptions of the design rules. Execution and workmanship are covered in Chapter 7, and are to be considered as minimum requirements which may have to be further developed for particular types of buildings and methods of construction⁹⁾.

P(4) Eurocode 5 does not cover the special requirements of seismic design. Provisions related to such requirements are given in Eurocode 8 “*Design of Structures in Seismic Regions*”¹⁰⁾ which complements Eurocode 5.

P(5) Numerical values of the actions on buildings and civil engineering works to be taken into account in the design are not given in Eurocode 5. They are provided in Eurocode 1 “*Basis of design and actions on structures*”¹⁰⁾.

1.1.2 Scope of part 1-1 of Eurocode 5

P(1) Part 1-1 of Eurocode 5 gives a general basis for the design of buildings and civil engineering works.

P(2) In addition, Part 1-1 gives detailed rules which are mainly applicable to ordinary structures. The applicability of these rules may be limited for practical reasons or due to simplifications; their use and any limits of applicability are explained in the text where necessary.

P(3) Chapters 1 and 2 are common to all Eurocodes, with the exception of some additional clauses which are required for timber structures.

P(4) This Part 1-1 does not cover:

- the design of bridges,
- resistance to fire,
- the design of structures subject to prolonged exposure to temperatures over 60 °C.
- particular aspects of special structures

1.1.3 Further parts of Eurocode 5

P(1) Further Parts of Eurocode 5 which, at present, are being prepared or are planned, include the following

Part 1-2 — Supplementary rules for structural fire design

Part 2 — Bridges (in preparation)

1.2 Distinction between principles and application rules

P(1) Depending on the character of the individual clauses, distinction is made in this Eurocode between Principles and Application Rules.

P(2) The Principles comprise:

- general statements and definitions for which there is no alternative, as well as
- requirements and analytical models for which no alternative is permitted unless specifically stated.

P(3) The Principles are preceded by the letter P.

⁹⁾ For the meaning of this term, see 1.4.1(2)

¹⁰⁾ At present at the draft stage